Chukchi Sea Play 15: Topset Sandstones (Lower Brookian)-North Chukchi Basin

Geological Assessment

GRASP UAI: AAAAA DAP
Play Area: 5,906 square miles
Play Water Depth Range: 150-330 feet
Play Depth Range: 9,914-28,500 feet
Play Exploration Chance: 0.063

Play 15, Topset Sandstones (Lower Brookian)-North Chukchi Basin, Chukchi Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas			
Assessment Results as of November 2005			
Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	414	1,356
Total Gas (Tcfg)	0.000	1.569	5.263
Total Liquids (Mmbo)	0	135	420
Free Gas** (Tcfg)	0.000	1.360	4.703
Solution Gas (Tcfg)	0.000	0.209	0.560
Oil (Mmbo)	0	61	165
Condensate (Mmbc)	0	74	255

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 15, the "Topset Sandstones-North Chukchi Basin" play, is the 13th-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 1.4% (414 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 15 are shown in table 1. Oil and gas-condensate liquids form 33% of the hydrocarbon energy endowment of play 15. Table 5 reports the detailed assessment results by commodity for play 15.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 15. Table 4 reports the risk model used for play 15. The location of play 15 is shown in figure 1.

Potential reservoirs are hypothesized to be deltaic sandstones of Cretaceous (possibly Late Cretaceous?) age that concluded an early cycle of filling of North Chukchi basin. We speculate that these deposits represent the filling of the basin to baseline prior to a second cycle of subsidence begun in Paleocene time. Traps are primarily north-trending horsts formed during early Tertiary time. The play is presumed to be charged by the North Chukchi basin play charging system. No rocks correlative to the proposed Upper Cretaceous(?) reservoir sequence of play 15 are present in any well on Chukchi shelf. The play was not tested by any Chukchi shelf well.

A maximum of 23 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 15. These 23 pools range in mean conditional (un-risked) recoverable volumes from 4 Mmboe (pool rank 23) to 349 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 61 Mmboe (F95) to 1,012 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 15.

Play 15, Topset Sandstones (Lower Brookian)-North Chukchi Basin, Chukchi Sea OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	61	349	1012
2	28	146	355
3	15	87	212
4	9	57	142
5	6	40	102
6	4	29	77
7	3	23	59
8	2.7	18	47
9	2.3	15	39
10	2.1	13	33

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

In the computer simulation for play 15 a total of 44,832 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 11 contains the largest share (8,877, or 20%) of simulation pools (conditional, technically recoverable BOE resources) for play 15. Pool size class 11 ranges from 32 to 64 Mmboe. The largest simulation pool for play 15 falls within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe. Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 15.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Chukchi Sea Planning Area
Play Number: 15
Play UAI Number: AAAAA DAP

Assessor: K.W. Sherwood
Play Name: Topset Sandstones (Lower Brookian) - North Chukchi Basin

Date: January 2005

Play Area: mi² (million acres) 5,906 (3.780)
Reservoir Thermal Maturity: % Ro 0.83 - 1.89

Play Depth Range: feet 9,914 - 28,500 (mean = 16,626)
Expected Oil Gravity: ° API 35
Play Water Depth Range: feet 150 - 330 (mean = 170)

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input*	574		1161		5087	9885/16471			22285				66550
Prospect Area (acres)-Model Output**	575	960	1310	2470	5259	8978/10439	11153	16543	21551	31035			66541
Fill Fraction (Fraction of Area Filled)	0.09	0.18	0.19	0.22	0.25	0.26/0.05	0.29	0.31	0.33	0.35			0.60
Productive Area of Pool (acres)***	93	228	318	607	1318	2308/2783	2816	4219	5518	8110	9600	11000	22246
Pay Thickness (feet)	35	84	95	118	150	160/58	190	216	236	268	310	341	600

* model fit to prospect area data in *BESTFIT*
** output from *@RISK* after aggregation with fill fraction
*** from *@RISK* aggregation of probability distributions for prospect area and fill fraction

MPRO Module (Numbers of Pools)

Input Play Level Chance	0.6
Output Play Level Chance*	0.5995

Prospect Level Chance	0.105

Exploration Chance	0.063

* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Closure Reliability (difficult seismic mapping due to very complex faulting)	0.7
	0.6	Reservoir Presence (Nanushuk-equivalent, with very little sandstone in Nanushuk sequence in wells to south on Chukchi Platform)	
		Chance Porosity > 10%	0.15

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	60	63	65	68	70	71.19/4.90	73	76	78	80	80.5	81	91
Numbers of Pools in Play					5	4.48/4.19	8	9	10	11	13	14	23

Zero Pools at F59.97

Minimum Number of Pools	4 (F55)	Mean Number of Pools	4.48	Maximum Number of Pools	23

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	14	32	38	48	66	78/45	94	114	133	164	190	210	500
Gas Recovery Factor (Mcfg/acre-foot)	361	781	886	1068	1353	1483/609	1732	2027	2247	2624	3100	3500	7253
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	1300	2550	2750	3075	3400	3393/586	3750	3950	4100	4300	4500	4625	5500
Condensate Yield ((bbl/Mmcfg)	13	29	33	40	50	54/19	64	72	79	90	105	120	200

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.618 σ^2 (sigma squared)= 1.737
Random Number Generator Seed= 245952

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.23
Probability Any Pool is 100% Oil	0.34	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5
Probability Any Pool is 100% Gas	0.43		

Table 3. Input data for Chukchi Sea play 15, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	15. Topset Sandstones (Lower Brookian) - North Chukchi Basin
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DAP
Date:	1-Jan-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***1.0000***	***1.0000***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	1.00
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***0.6000***	***0.1500***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	0.60	1.00
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.15
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.7000***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.70
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00
	Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)		***0.6000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
	Average Conditional Prospect Chance[1]			***0.1050***
	(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*			
	[1] Assumes that the Play exists (where all play chance factors = 1.0)			
	Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide			
	Exploration Chance		***0.0630***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

2b: Chance That Porosity >10%, Based on Regional Model for Porosity vs Reservoir Thermal Maturity

Table 4. Risk model for Chukchi Sea play 15, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region

GRASP Model Version: 8.29.2005)

Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAADAP**		**Play No.**		**15**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**		**SHELF**	
Play	**Level**	**-**	**Play**		**15**	**Topset Sandstones (Lower Brookian)**	
Geologist	Kirk	W.	Sherwood			**- North Chukchi Basin**	
Remarks	2005	Assessment					
Run Date & Time:		Date	19-Sep-05	Time		13:54:55	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	414,240	507,470
Oil (Mbo)	61,390	104,880
Condensate (Mbc)	73,643	102,520
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	1,360,200	1,822,800
Solution Gas (Mmcfg)	208,960	369,010

10000 (Number of Trials in Sample)

0.5995 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	15,032	4,553	1,676	34,032	15,441
55	187,900	36,351	29,919	560,960	122,630
50	279,170	56,064	43,496	818,590	190,810
45	350,830	78,407	52,042	976,070	262,480
40	427,710	78,300	69,698	1,307,400	264,580
35	507,800	88,913	82,754	1,584,200	304,840
30	586,910	96,145	98,065	1,876,900	330,030
25	677,240	111,490	114,710	2,149,700	385,170
20	776,890	119,170	134,560	2,516,900	423,280
15	906,340	134,890	156,730	2,994,000	460,730
10	1,070,700	141,440	194,710	3,643,400	484,670
8	1,163,500	155,150	213,460	3,947,800	519,580
6	1,285,700	147,060	251,910	4,491,500	492,030
5	1,356,200	164,720	255,050	4,703,200	559,530
4	1,444,300	184,860	273,510	4,895,800	645,200
2	1,778,300	201,910	343,490	6,234,100	695,020
1	2,090,200	176,060	423,550	7,778,800	598,310
0.1	3,486,400	769,100	612,890	9,347,000	2,479,700
0.01	4,719,300	212,770	858,630	19,718,000	782,770
0.001	8,059,100	4,189,500	187,550	4,360,700	16,332,000

Table 5. Assessment results by commodity for Chukchi Sea play 15, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 15 - L. Brookian N Chukchi Basin - Topset
UAI Key: AAAAADAP

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range		Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
3	0.125	0.25	1	0.002231	0.0001	0.000167		0	1	0	0	0	1	1	0	0	1	1	0.183418	0.183418	0.183418	183.417529
4	0.25	0.5	4	0.008922	0.0004	0.000667		0	4	0	0	0	1	1	0	0	1	1	0.328220	0.440344	1.530730	382.682383
5	0.5	1	77	0.171752	0.0077	0.012842		2	70	5	1	1	1	1	1	1	1	1	0.545352	0.998610	62.150856	807.154000
6	1	2	390	0.869914	0.039	0.065043		35	333	22	1	1	1	2	1	1	1	2	1.000555	1.997142	607.256554	1.557068
7	2	4	1428	3.185225	0.1428	0.238159		197	1067	164	1	2	1	4	1	2	1	4	2.002388	3.998535	4418.145000	3.093939
8	4	8	3196	7.128837	0.3196	0.533022		556	1952	688	1	3	1	4	1	2	1	5	4.000013	7.998818	19163.494000	5.996087
9	8	16	5798	12.932727	0.5798	0.966978		1332	2798	1668	1	4	1	4	1	3	1	8	8.000801	15.999500	68309.031000	11.781482
10	16	32	8002	17.848858	0.8002	1.334556		1924	3000	3078	1	4	1	4	1	5	1	7	16.000112	31.999189	187017.552000	23.371351
11	32	64	8877	19.800589	0.8877	1.480487		2193	2756	3928	1	5	1	4	1	5	1	8	32.009298	63.999232	409681.167000	46.150860
12	64	128	7923	17.672644	0.7923	1.321381		2038	1932	3953	1	4	1	4	1	6	1	8	64.014089	127.975914	721348.502000	91.044869
13	128	256	5512	12.294789	0.5512	0.91928		1373	980	3159	1	4	1	3	1	4	1	6	128.012767	255.982484	988529.787000	179.341400
14	256	512	2630	5.866345	0.263	0.438626		574	261	1795	1	2	1	2	1	4	1	4	256.091817	511.740627	929054.315000	353.252594
15	512	1024	821	1.831281	0.0821	0.136925		138	53	630	1	2	1	1	1	3	1	3	512.334292	1023.162000	554375.306000	675.243958
16	1024	2048	157	0.350196	0.0157	0.026184		20	9	128	1	1	1	1	1	2	1	2	1024.952000	2031.582000	210587.205000	1.341320
17	2048	4096	15	0.033458	0.0015	0.002502		0	3	12	0	0	1	1	1	1	1	1	2087.235000	3817.782000	41446.841000	2.763123
18	4096	8192	1	0.002231	0.0001	0.000167		0	1	0	0	0	1	1	0	0	1	1	7816.300000	7816.300000	7816.300000	7.816300
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0								Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**44832**	**100**	**4.4832**	**7.476985**	Above Class	0	0	0								Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 5996

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 15, 2006 assessment.

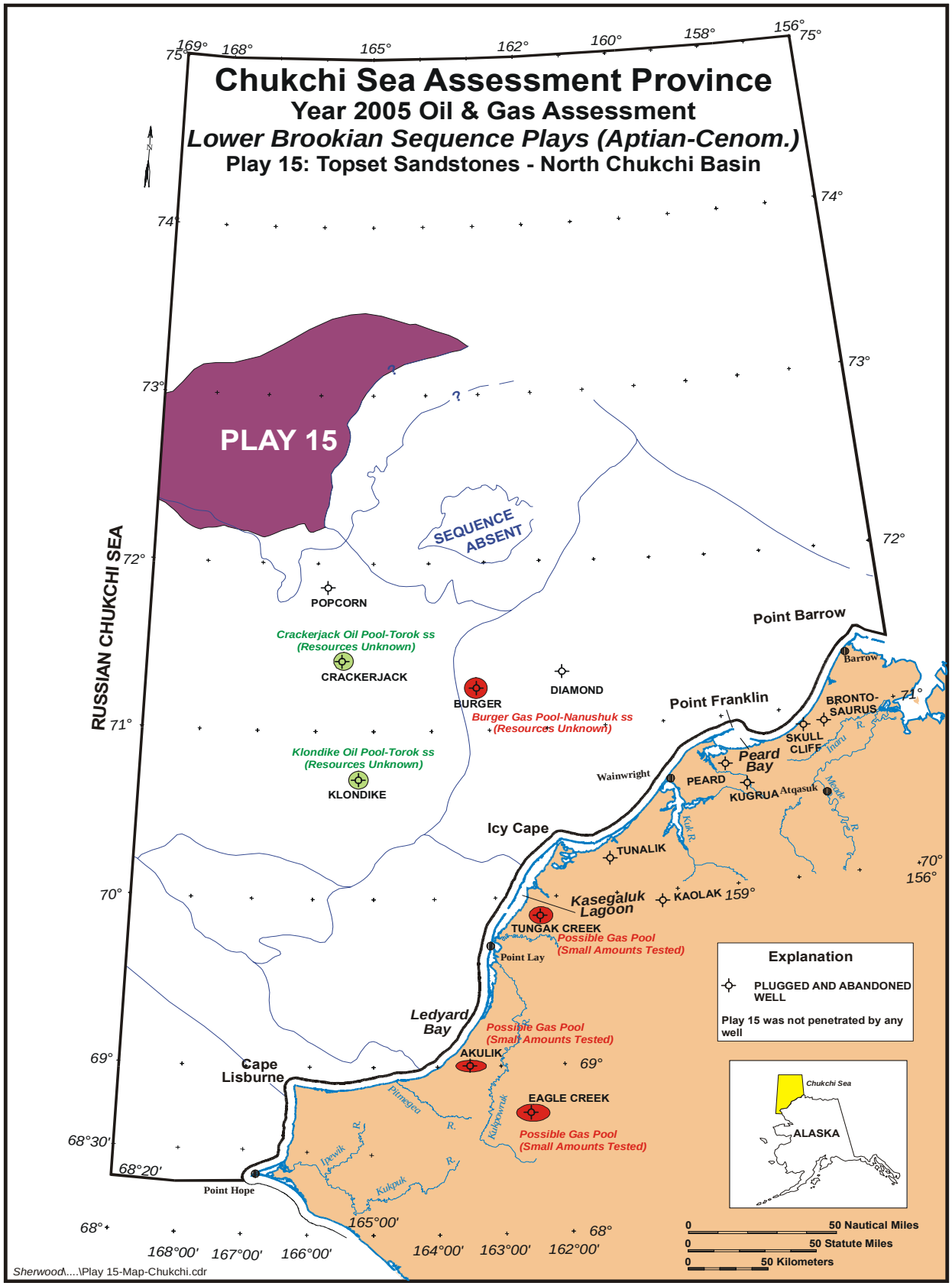

Figure 1. Map location of Chukchi Sea play 15, 2006 assessment.